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USING TERRESTRIAL STEREO PHOTOGRAPHY TO INTERPRET CHANGES IN TREE QUALITY CHARACTERISTICS

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Abstract. A technique is described for using stereo photography to evaluate tree quality changes over time. Stereo pairs were taken four times over an 18-year period. All four faces of the selected trees were photographed. Individual defect changes are shown for young upland white oak trees.

Worley and Dale (1960) described a method to record tree defects in stereo. No analytical methods or techniques were described to quantify defect change over time. This paper incorporates the use of stereo photography for defect orientation and a technique for measuring and analyzing individual quality-related variables as they change over time. Because the changes in tree quality characteristics are an integral part of total tree development, the study was designed to stereo photograph and examine limb-related defects four times over an 18-year period.

In 1960, sixteen 1-acre plots were established on the Daniel Boone National Forest in Kentucky. On each plot five trees were selected and stereo photographed to study growth and quality. The same 80 trees, all white oaks, were stereo photographed in 1965, 1972, and 1978. The stereo photos provided a photo data-bank for 18 years of growth and quality change.

The plots were maintained at stocking levels of 20, 40, 60, and 80 square feet of basal area. Tree diameters ranged from 6.5 inches to 14.0 inches in 1960, and 10.0 inches to 16.5 inches in 1978.

STEREO-PHOTO TECHNIQUE

The stereo pairs were taken of each tree bole from the four cardinal directions with a Crown Graphic camera[1] mounted on a slide base. Each photograph included at least the butt 33-foot section of the tree bole. A metal telescoping measuring pole marked in 1-foot intervals was used to determine heights (Fig. 1).

Stereo pairs were analyzed in the office using a pocket stereoscope. Tree boles were examined to a height of 17.3 feet. The quality classification system (Sonderman and Brisbin 1978) was used to measure and record the quality-related variables from each tree. The following variables were measured and recorded:

1. The number of primary limbs on each 8-foot section of the lower 16 feet of the tree bole. Only limbs $\geqslant 1/3$ inch were counted and tallied by live and dead categories.
2. The size of the single largest live and dead limb for each 8-foot section. Only limbs $\geqslant 1/3$ inch were recorded. The diameter of the measuring pole was used to estimate limb size.
3. Stem curvature was estimated in inches for the butt 16-foot section of each tree.
4. The number and extent of defect indicators (rots and seams) in the butt 16-foot section of the tree bole.
5. The number of epicormic branches in each 8-foot section of the butt 16-foot portion of the tree.
6. The number of measurable overgrowths (Sonderman 1979) in each 8-foot section of the tree bole.
7. The height, in feet, of the first fork in the butt 16-foot section of the tree bole.

Total height, crown class, crown ratio, and dbh were determined each time the trees were photographed.

Figure 1.—Stereo pair.

[1] The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture or the Forest Service of any product or service to the exclusion of others that may be suitable.

INTERPRETATION OF PHOTOS

The quality of young hardwood trees is determined by the condition, size, and extent of naturally occurring external characteristics. The stand density, aspect, and moisture all have a direct relationship to total height, dbh, crown class, crown ratio, size and number of live and dead limbs, stem curvature, epicormic branch development, forking, and external defects.

A detailed record of specific defect change and development can be made by analyzing stereo pairs at different photo intervals. Limb size, epicormic branching, and overgrowths can be recorded from one photo-measurement period to the next. Figures 2 through 5 show a progression of three individual quality changes. The inset photos indicate the detail that can be seen by examining stereo pairs. For example, the 1-inch live limb shown in Figure 2A in 1960 was dead by 1965 (Fig. 3A), but still remained on the tree in 1972 (Fig. 4A). However, by 1978 (Fig. 5A) the limb had fallen off and an overgrowth had formed. The natural pruning of this limb is possibly a result of live-limb behavior when a tree remains in a densely stocked stand. If the stand had been released to 30 square feet of basal area, the results might have been much different.

Figure 2A also shows a small 1/8-inch epicormic branch formed at the base of the above mentioned 1-inch branch. In 1965 (Fig. 3A) and 1972 (Fig. 4A) the epicormic branch was still alive and had grown to 1/4 inch and 1/3 inch, respectively. The epicormic branch was almost 1/2 inch by 1978 (Fig. 5A).

Figure 2B shows a 3/4-inch live limb in 1960. Between 1960 and 1965 this limb grew to 1 inch, but by the time the 1965 photo (Fig. 3B) was taken the limb had died. This dead limb remained on the tree another 7 years (Fig. 4B), and by 1978 (Fig. 5B) the limb had fallen off and an overgrowth remained as a past-limb indicator.

Figure 2C shows the start of a butt swell. The size and form of the butt swell appears to be diminishing (Fig. 3C and 4C), but this is an illusion because the swell remained and the tree increased in diameter (Fig. 5C). The progression shows that the absolute butt swell has stayed about the same and the relative butt swell is diminished because of tree growth.

Other tree quality characteristics that can be measured and interpreted from stereo pairs are stem curvature and forks. Stem curvature can be measured on the photograph by applying a straight edge directly along each tree bole, and then estimating the inches of departure for a given set of tree photos.

COMPARISON

For comparison, 30 white oak trees were evaluated by the quality classification system using the relative quality index (Sonderman and Brisbin 1978). The trees were evaluated in the field, and also by stereo-photo analysis in the laboratory. The results of the comparison showed that 83 percent of the trees had no change in relative quality class, and the remaining 17 percent were misclassified by only one quality class. Misclassification occurred only in the "good" and "medium" relative quality classes.

APPLICATION

The technique of interpreting stereo-pair photography provides an insight into how and why quality-related defects in trees develop and change under different cultural treatments. Interpretation of stereo photos aids in developing procedures for stratifying quality in cultural treatment studies, and provides previously unavailable information on the quality development of certain tree species. Actual results will be published in a future publication that describes the effects of thinning treatments on tree quality characteristics and growth for 18 years. The forthcoming publication will feature white oak quality development under different stocking levels and will link quality development, as recorded by this system, to silvicultural parameters.

Figure 2.—1960.

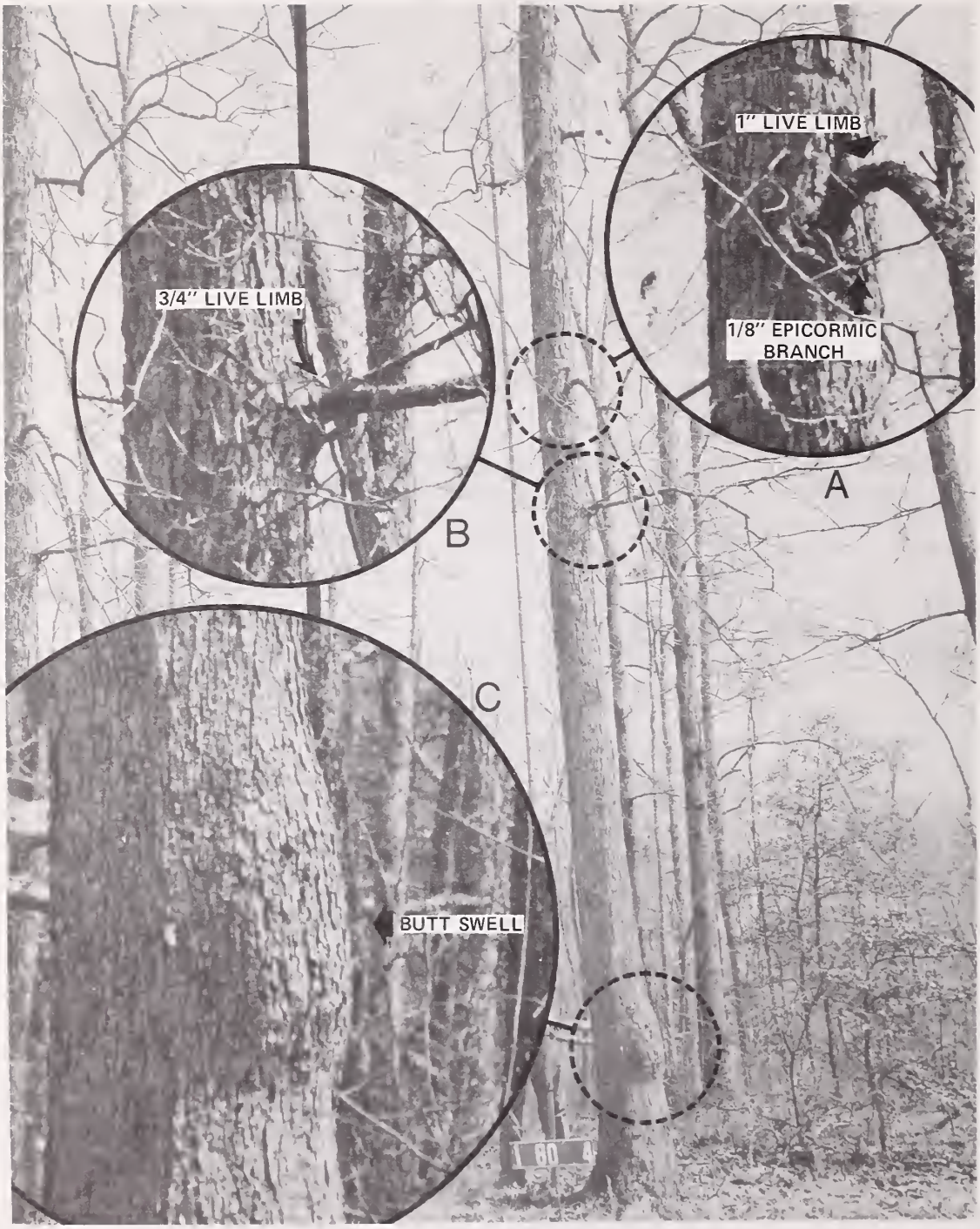

Figure 3.—1965.

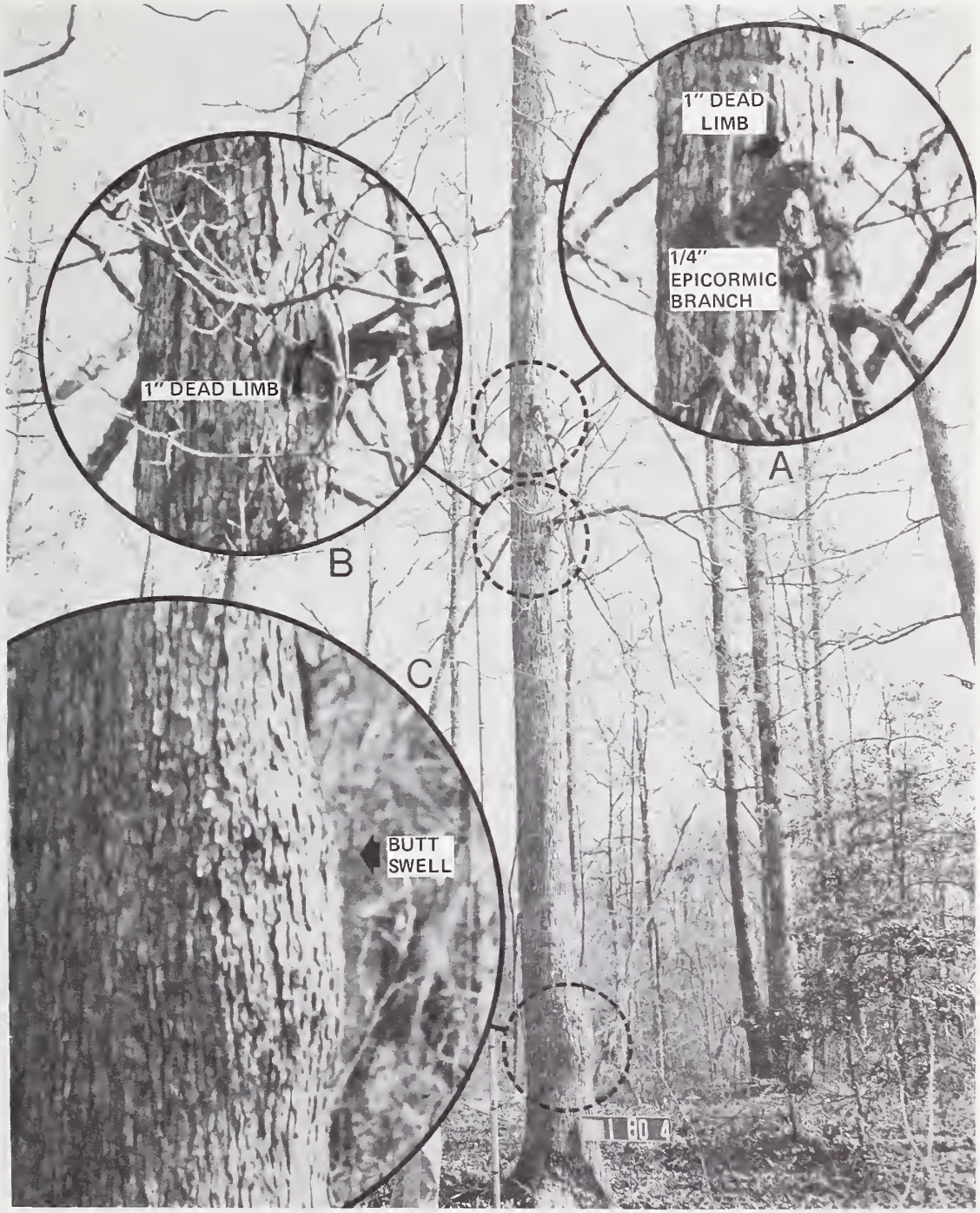

Figure 4.—1972.

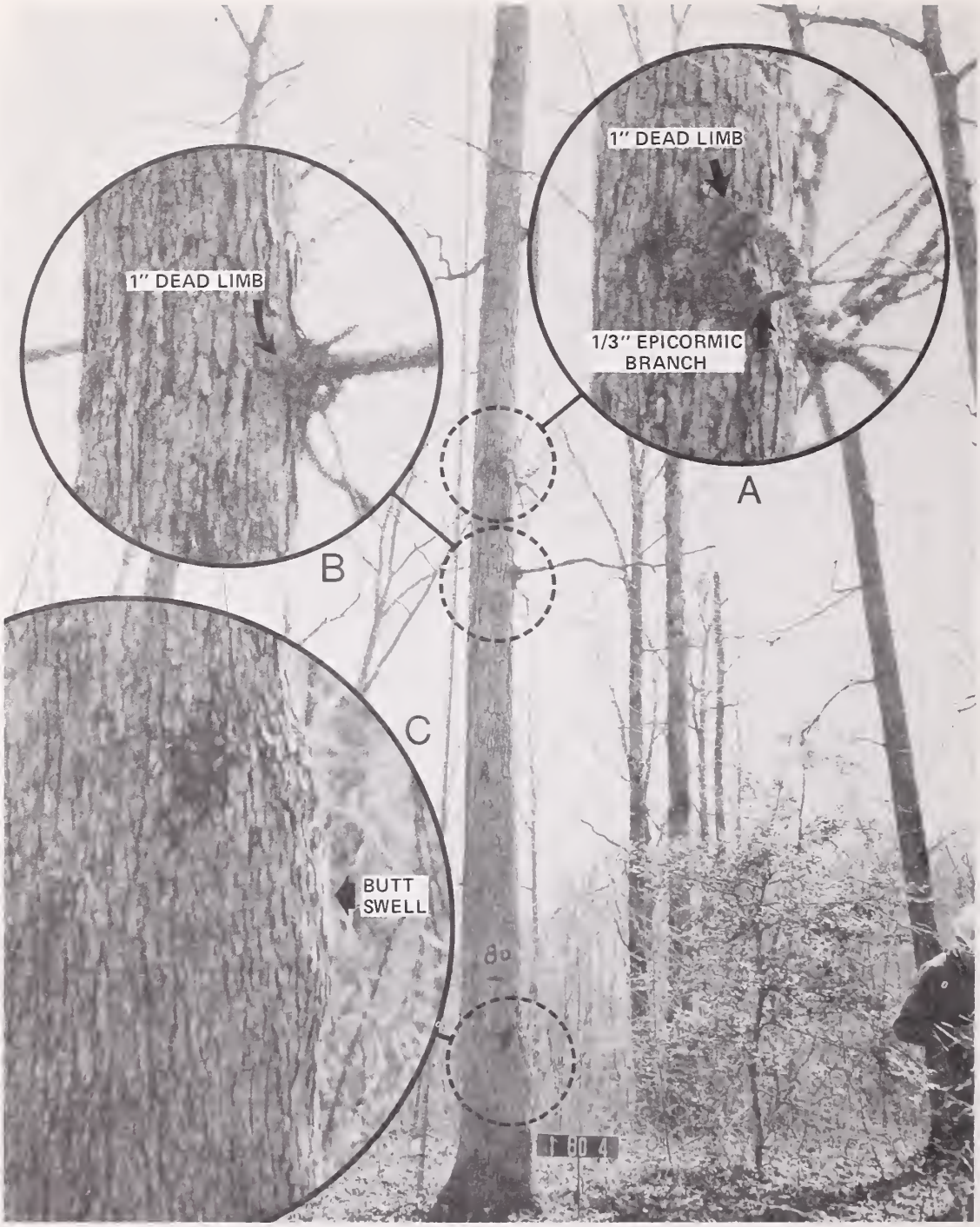

Figure 5.—1978.

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